Knowledge Economy, Global Innovation Indices, Rents and Governance in Arab Economies

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Abstract

This paper sheds light on the relationship between knowledge, innovation, rents from natural resources and governance in world economies with focus on Arab countries. Two major analytical frameworks are used with the first based on the use of knowledge indicators while the second is on the Global Innovation index (2010-2016). Both models confirm the negative effects of rents and the positive roles of good governance, on knowledge and innovation. Arab countries appear to exhibit clearly these effects with higher emphasis on governance indicators. Also, Arab countries appear to exhibit a model that is statistically different from the one of all countries. This work complements that of Driouchi (2014a and 2014b) with the inclusion of the Global Innovation Index data 2010-2016.

JEL: O32, O13, Q28.

Keywords: Rents, natural resources, governance, knowledge economy, global innovation index

Introduction

When one looks at the rankings of Arab Countries in both knowledge economy and innovation as provided annually respectively by the World Bank and INSEAD, it is difficult to see the determinants and differences between countries, except from data on the endowment in natural resources and mainly oil and gas. Also, Arab countries have been discovering only few new opportunities that are directly or indirectly related to their dominant and traditional economic and business activities. Outside mining, real-estate, tourism,

commerce, agriculture and logistics, only few opportunities have been discovered during the last years. As some of these countries are already facing the post-oil era in relation to the trends taking place in mining and in oil and gas industries, with future possibilities of exhaustion of oil and gas reserves, diversification of economic activities has been emerging in some of these economies. But, the creation of new portfolios has not been expanded outside the traditional spectrum of economic activities. Besides that, Governments and public sovereign funds are still playing an important role both domestically and internationally implying that rents from natural resources are still promising sources for economic development. In addition rents are pervasive and exist in all countries, but do we have significant differences in the models governing knowledge and innovation?

This paper is a follow-up to previous contributions of Driouchi (2014a and 2014b).

In these latter contributions, the author addresses series of questions: How rents are driving the development path in relation to adhesion of most world countries to the gains from the new economy? How have knowledge variables been related to rents obtained from natural resources? Do natural resources constitute a curse or a favoring factor of development? The answers have been provided through series of analyzes using mainly the Knowledge Economy Index and its components in relation to rents from natural resources.

The present paper introduces a literature review and a methodological framework followed by the empirical results obtained from both the use of knowledge indices and global innovation index. This has allowed for a discussion of the impacts of these results on the development path of Arab countries with focus on GC. The comparative results attained are also used to discuss the effects of rents on different types of economies.

I. Literature Review

The earliest paper is by Sachs and Warner (1997) where the authors observe that economies with a high ratio of natural resources to GDP in 1970, tend to grow slowly during the period

1970-1990. Series of publications have then developed to show the interests that have been expressed over years to the empirical relationship between oil rents, economic performance and development. Besides the authors that emphasize the curse effect, more researchers insist on the positive effects under the conditionality of further transparency in allocating the revenues generated for natural resources. But, other authors consider that the system of governance does affect the way revenues are generated and distributed. They base their approach mainly on the political economy of the country and suggest shifts to democratic and transparent systems as means to enhance distribution of revenues and enhanced welfare. Authors are claiming though, that the observed conflicts in different locations characterized by oil and mineral abundance are mainly related to the absence of transparent and democratic systems in the locations and countries considered. Mineral resources could also be important sources of wealth under promising schemes of management.

Such research trends include those by Ebeke and Ombga (2011), Gelb and Grasmann (2009), Luciani (2008), Sturm et al. (2009), El Anshary (2011), Farzanegan and Schneider (2009), Paltseva and Roine (2011), Gauthier and Zeufack (2009), Mehlum and Torvik, (2008), Cappelen and Mjoset (2009), Cotet and Tsui (2010a), Hartzok (2004), El-Katiri, Fattouh and Segal (2011), Kurtz and Brooks (2011), Gurses (2009), Carneiro (2007) and Bretschger and Valente (2011). Cotet and Tsui (2010b), Davis and Tilton (2005), Brooks and Kurtz (2012), Mohadess (2012), Ross (2012), Frankel (2010) and Gaitan and Roe (2012) add new types of knowledge to rents in natural resources. Akarli (2007) studies the situation of six Arab countries in the Gulf Region (Saudi Arabia, United Arab Emirates, Kuwait, Qatar, Oman and Bahrain) where it has been shown that their natural resources constitute a blessing for each country as it increases their economic revenues and standards of living. Clement (2004) claims that the oil rent can be either a curse or a blessing for Algeria.

Series of relatively new research papers are still being produced on sets of empirical questions related to the effects and the links between natural resources and governance variables both at local and global levels. These include Busse & Gröning (2011), Farzanegan, Lessmann & Markwardt (2013), Cotet & Tsui (2010b), Loayza, Mier y Teran and Rigolini (2013), Fleming and Measham (2013), Leonov and Volchkova (2013), Konte (2012), Ragnar (2009) Malik (2013) praises the research of Ragnar (2009) and Weber (2013). Perez (2015) considers that natural resources present an opportunity for Latin America and other resource-rich countries. Brown, Fitzgerald & Weber, (2016) focus on innovation and growth in oil and gas from shale formations led the U.S. to become global leader in this area. In addition, other authors such as Van Der Ploeg & Poelhekke (2016), Hamid & Sami (2016), Hamid & Omnia A. A. (2015), Venables (2016), and Oakes (2016) have been adding new dimensions to the methods and to the political economy of rents from natural resources.

II. Methods and data

In the sense of World Bank data, rents are measured as percentages of GDP in each country. As such, the total rent from natural resources includes those from exhaustible resources (oil, gas and coal) and that from a renewable resource that is forestry. Rents account for the difference between valuations at world prices and domestic production costs (World Bank, 2011). For oil and gas, the related rents are consequently the difference between the value of crude oil at world prices and the total costs of its production. Similarly, the forestry rents are measured by the flow of forest products valued at both world prices and domestic costs of their production.

Based on World Bank datasets (World Bank, 2011), rents are considered to be originating from oil and gas, coal extraction and forestry activities. As they are representing the excess returns between their valuation at international world prices and their domestic production costs, each value is composed of both quantity and price effects. In order to investigate the

likely trends taking place in each economy, the quantity effect is first described through variables represented by the percent area of land covered by forests and the total energy produced in oil equivalent (World Bank, 2011).

Besides data on knowledge, data on global innovation index from INSEAD in addition to data related to governance indicators are used to perform regressions where the dependent variables are either knowledge or innovation and their pillars. The explanatory variables are rents and governance indicators.

III. Results of the Empirical Analysis

The results are introduced in relation to the knowledge economy index and to the global innovation index, respectively.

1. Using Knowledge Economy Index (KEI) and its components

This part of the results is taken from Driouchi (2014a and 2014b) where the above concerns are related to the rents with knowledge variables, to test whether they facilitate or constrain access to knowledge and development. Regressions are pursued to test these hypotheses in the context of the overall world sample and for Arab countries. For that purpose the components of Knowledge Economy are used (World Bank, until 2012). They are represented by education (EDU), innovation (INN), economic incentives regime (EIR) and information and communication (ICT) besides the indices knowledge index (KI) and KEI. The average rents are used as explanatory variables under different combinations but the AVG2000 as the average rents during the years 2000 (meaning from 2000 to 2010) appear to capture the variable needed in the regressions given below.

Table 1: Effects of rents on knowledge variables: Overall World Sample

Dependent Variable	Constant	AVG 2000	ICT	R^2	N° Observations
EDU	0.028 (.658)	-0.042 (-1.980)	0.913 (15.492)	0.761	95
INN	0.294 (10.314)	-0.043 (-3.019)	0.620 (15.553)	0.772	95
EIR	0.341 (5.098)	-0.106 (-3.196)	0.483 (5.169)	0.364	95

KI	0.149 (7.669)	-.028 (-2.942)	0.796 (29.308)	0.918	95
KEI	.222 (10.179)	-0.043 (-3.932)	0.697 (22.888)	0.878	95

In the overall sample of 95 countries, the relationships between each knowledge variable selected as independent variable, a high level of linearity is established (as shown by R^2 that is between 0.364 and 0.918). The explanatory variables that show statistically significant (1% level) effects (except EDU that is significant at 5 % level) on each of the knowledge variables, are the average rate of total rents as percent of GDP over the period 2000-2009 (AVG 2000) and ICT that also exhibits statistically significant effects. The above results show that knowledge variables are highly sensitive to the average rate of rents and to ICT. While the effects of ICT are all positive and good drivers of the other knowledge variables, the effects of rents are all negative. This implies that any increase (decrease) in rents decreases (increases) the related knowledge variable.

Table 2: Effects of rents on knowledge variables: **Arab Countries**

Dependent Variable	Constant	AVG 90	AVG2000	AVG70	R²	N° Observations
ICT 12	0.605 (6.705)	-0.011 (-0.045)	-0.269 (-1.204)	0.337 (1.631)	0.239	16
EDU12	0.588 (5.658)	0.211 (0.454)	-0.644 (.028)	0.430 (0.096)	0.364	16
INN12	0.617 (10.782)	0.143 (0.359)	-0.507 (.004)	0.378 (.014)	0.557	16
EIR12	0.603 (10.914)	0.063 (0.437)	-0.835 (-6.104)	0.806 (6.373)	0.821	16
KI12	0.613 (8.252)	0.097 (0.499)	-0.433 (-2.350)	0.358 (2.102)	0.372	16
KEI12	0.615 (9.561)	0.080 (0.473)	-0.494 (-3.105)	0.439 (2.983)	0.523	16
ICT09	0.684 (9.618)	0.065 (0.347)	-0.275 (-1.563)	0.226 (1.385)	0.207	16
EDU09	0.586 (6.533)	0.215 (0.912)	-0.496 (-2.234)	0.292 (1.424)	0.305	16
INN09	0.625 (13.247)	0.034 (0.273)	-0.347 (-2.965)	0.316 (2.921)	0.501	16
EIR09	0.600 (11.015)	-0.009 (-0.061)	-0.820 (-6.073)	0.860 (6.894)	0.833	16

KI09	0.639 (10.601)	0.086 (0.547)	-0.346 (-2.318)	0.269 (1.948)	0.351	16
KEI09	0.634 (11.846)	0.055 (0.394)	-0.412 (-3.112)	0.371 (3.031)	0.525	16

As they are limited observations in the group of Arab countries (16), the explanatory variables used that appear to provide good responses are the average rents of 1970 (AVG70) (1970-1979), the average of 1990 (AVG90) (1990-1999) and the average of rents over 2000-2009 (AVG2000). Under this framework that appears to be statistically relevant with R^2 between 0.207 and 0.833, the AVG 90 variable does not exhibit statistically significant effects. But, AVG2000 and AVG70 show statistically significant results for the variables EIR12, KI12, KEI12, EDU09, INN09, EIR09 and KI09 and KEI09. The level of significance is 5 % for KI12, EDU09 and KI09. It is 1 % for the other variables (EIR12, KEI12, INN09, EIR09 and KEI09. In some cases, both effects of AVG2000 and AVG70 are observed.

While the effects of the average rents for the period 2000-2009 are negative, the effects of the average rents over the period 1970-1979 are positive. This means that over the period 2000-2009, the increase in rent decreases the related knowledge variables. But, the net effects: EIR12 (-0.835 and 0.806), for KEI12 (-0.494 and 0.439), for KI12 (-0.433 and 0.358), for INN09 (-0.347 and 0.316), for EIR09 (-.830 and 0.860), and for KEI09 (-0.412 and 0.371) could be negative. This implies that the net effect of average rents is negatively related to most knowledge variables as represented by the above components.

Is there a change in rent structure and what are the likely effects on knowledge variables? This leads to considering the regressions of knowledge variables on differencing and then the squared differences of rents to capture the effects on knowledge variables.

Table 3: Effects of differential rents as shown below the table: **Arab Countries**

Dependent Variable	**Constant**	**Diff**	**DiffSqu**	**R^2**	**Observations**
KEI09	0.636 (16.845)	-.419 (-2.159)	0.044 (0.185)	.517	16

KI09	0.632 (16.997)	-0.302 (-2.652)	-	0.334	16
EIR09	0.657 (17.997)	-0.614 (-3.268)	-0.335 (-1.443)	.846	16
INN09	0.622 (21.549)	-0.329 (-3.724)	-	0.498	16
EDU09	0.557 (9.856)	-0.380 (-2.196)	-	0.256	16
ICT09	0.659 (14.218)	-0.545 (-2.286)	0.436 (1.483)	0.312	16
KEI12	0.620 (13.599)	-0.522 (-2.224)	0.086 (0.296)	0.510	16
KI12	0.618 (13.454)	-0.390 (-2.773	-	0.354	16
EIR12	0.647 (17.225)	-0.608 (-3.142)	-0.310 (-1.296)	0.83	16
INN12	0.601 (14.512)	-0.475 (-2.227)	0.060 (0.228)	0.525	16
EDU12	0.546 (8.378)	-0.522 (-2.620)	-	0.329	16
ICT12	0.630 (10.314)	-0.675 (-2.150)	0.538 (1.388)	0.287	16

Note : *Diff=Difference between log (%Rent in GDP, Average 2000-2009) and log (% Rent in GDP, Average 1970-1997) and *DiffSqu=Diff squared.

The above regression results show that all indices and sub-indices related to knowledge economic index are negatively related to the explanatory variable representing the rate of rents in GDP per country. The indices used as independent variables in these regressions account for the difference between the average of the logarithmic values over the years 2000-2009 of the percent rent in GDP per country and the logarithmic values over the years 1970-1979 of the percent rate in GDP per country. It also includes the squared value of this index. But, in these regressions, the coefficients related to the squared values of the index appear to be statistically not significant.

These results show that the overall KEI of 2009 and of 2012 have respective coefficients of -0.419 and -0.522 while the related KI for the same years exhibit responses of -0.302 and -0.390 respectively for 2009 and 2012. Similarly, when INN09, INN12 are the dependent variables, the respective effects are -0.329 and -0.475. EDU09 and EDU12 exhibit also

responses that are -0.380 and -0.522. The levels of responses of ICT09, ICT12, EIR09 and EIR12 are given as -0.545, -0.675, -0.674 and -0.608.

The results show how the rate of rent in GDP per country influences the level of knowledge attainment as this is measured by knowledge economy and knowledge indices besides the sub-components of the KEI. Otherwise, larger dependency on oil, gas and forestry rents as included in the World Bank data lowers the levels of knowledge attainment in case of positive values of the coefficients on the independent variables. Countries with lower rents might have higher levels in the knowledge attainment indices in case of positive values of the independent variable. These coefficients can be interpreted as effects of rents on knowledge gains or losses for countries. Those with higher levels of rents have higher costs in the knowledge sphere while lower costs are observed in countries with lower dependency on oil, gas and forests. Countries such as Lebanon, Morocco, Tunisia, Bahrain, UAE, Qatar, Kuwait, Oman and Saudi Arabia are having extra-benefits in the area of knowledge from the rent economy. Jordan, Egypt, Mauritania, Sudan, Syria, Yemen and Algeria are those countries that pay knowledge tribute to their rent based economy.

2. Using the Global Innovation Index (GII) and its components

This part uses Global Innovation Index (GII) and its pillars as they are published in INSEAD 2009-2010, 2011, 2012, 2013, 2014, 2015 and 2016 reports (INSEAD). In addition to GII, its pillars are also considered in series of regressions where the explanatory variables are oil, forest and total rents besides governance indicators (World Bank), as defined below:

GII + year: is the index output for each corresponding year
Pil01: The first pillar "Institution"
Pil02: The second pillar "Human Capital & Research"
PIL03: The third pillar "Infrastructure"
PIL04: The fourth pillar "Market Sophistication"
PIL05: The fifth pillar "Business Sophistication"
PIL06: The sixth pillar "Scientific Outputs"
PIL07: The Seventh pillar "Creative outputs"
Oil rent
Forest rent
Gov01: Voice and Accountability

GOV02: Political Stability No Violence
GOV03: Government Effectiveness
GOV04: Regulatory Quality
GOV05: Rule of Law
GOV06: Control of Corruption

Regressions are performed for all countries and for the group of Arab economies. The respective results are introduced in tables 4 and 5.

As in table 5, GII and its components appear to be sensitive to at least one measure of rents with statistically negative significant coefficient and to governance with positive significant coefficients.

Table 4: Coefficient estimate of responses of rents and governance to GII and its pillars for all countries (average 2010-2016)

All countries	R-square	Forest rent	Oil rent	Total rent	GOV01	GOV02	GOV03	GOV04	GOV05	GOV06
GII	0.761			-0.016 (-2.361)			0.128 (4.103)		0.099 (3.282)	
PIL01	0.759						0.043 (2.221)		0.103 (5.533)	
PIL02	0.592						0.125 (2.433)		0.136 (2.753)	
PIL03	0.673	-0.019 (-2.240)					0.103 (2.695)		0.098 (2.790)	
PIL04	0.523						0.169 (3.732)			
PIL05	0.68						0.129 (3.274)		0.108 (2.832)	
PIL06	0.59			-0.042 (-2.969)			0.211 (3.039)			
PIL07	0.544								0.128 (2.665)	

As in table 5, GII and its components appear to be sensitive to a measure of rent with negatively statistically significant coefficients and to governance indicators. But some of the pillars are not responsive to the explanatory variables. This might introduce differences between all and Arab countries.

Table 5: Coefficient estimate of responses of rents and governance to GII and its pillars for Arab countries (average 2010-2016)

Arab countries	R-squared	Forest rent	Oil rent	Total rent	GOV01	GOV02	GOV03	GOV04	GOV05	GOV06
GII	0.999		-0.029 (-26.649)				0.123 (33,808)		0.061 (9,352)	
PIL01										
PIL02										
PIL03										
PIL04	0.73	-0.043 (-2.419)							-0.275 (-3.182)	
PIL05	0.974		-0.055 (-3.611)				0.262 (5.204)			
PIL06										
PIL07	0.87		-0.083 (-2.312)							

In order to compare the results of Arab countries to the overall model estimation, an F test is performed. The results of this test as introduced in table 7. The critical F value for 11 (total Arab countries) and 111 (total number of countries) degrees of freedom at 5 % significance is 2.46.

Table 6: Comparisons of results of Arab and all countries using F-test

Arab countries compared to all	F-test calculated	Critical F-test
GII	22.55	2.46
PIL01	12.91	2.46
PIL02	58.21	2.46
PIL03	5.59	2.46
PIL04	12.34	2.46
PIL05	6.36	2.46
PIL06	34.74	2.46
PIL07	5.63	2.46

This comparison implies that the estimated models for Arab countries are statistically different from the model obtained for all countries. This says that while rents and governance

are respectively constraining and favoring innovation and its pillars in Arab countries as in all economies, there are differences in the estimated respective models.

IV. Discussion and Conclusion

The existence of rents from either renewable or exhaustible natural resources appears to be constraining progress of knowledge and innovation in all and in Arab countries as tested through two major methods. The first one is based on knowledge economy index and its pillars. The second is based on the global innovation index and its pillars. But governance indicators are also included in this latter model. Both models are conclusive about the negative effects of rents with the second model emphasizing the positive role of governance indicators. But, Arab countries appear to have estimated models that are statistically different from the model from the larger sample of countries.

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